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STATEMENT UNDER 37 C.F.R. 1.55(a)

Sir,

I, Tomonori Nakamura, hereby declare that I am conversant with both English and Japanese languages, and certify to best of my knowledge and belief that the attached are true and correct English translation of Japanese Patent Application No.2001-053325.

A handwritten signature in black ink, appearing to read "T. Nakamura", written over a horizontal line.

Tomonori Nakamura

Date: August 21, 2003

PATENT OFFICE
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**This is to certify that the annexed is a true copy of the following application
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Specification

[Title of the Invention] Carriage Supporting Structure

[Claims]

[Claim 1] A carriage supporting structure included in recording apparatus comprising a carriage for carrying a recording head and for reciprocating in a main scanning direction, and a first carriage guide plate bent in directions opposite to each other so as to have a Z-shaped section and having three faces parallel to said main scanning direction, said recording paper being transferred in a sub scanning direction for recording; characterized in that

said first carriage guide plate is formed integrally from a main frame of said recording apparatus so as to dispose a middle face of the Z shape parallel to a head face of said recording head, said middle face of the Z shape being a first position defining face for defining a distance between the head face of said recording head and the recording surface of said recording paper and for supporting said carriage.

[Claim 2] A carriage supporting structure as claimed in Claim 1, characterized in that said carriage has a first guide member, said first guide member slidably

contacting with said first position defining face and reciprocating in said main scanning direction.

[Claim 3] A carriage supporting structure as claimed in Claim 2, characterized in that said first guide member slidably contacts with said first position defining face adjacent to a center line in the sub scanning direction.

[Claim 4] A carriage supporting structure as claimed in any one of Claims 1 through 3, characterized in that one of the outside faces of said Z shape of said first carriage guide plate is a second position defining face for defining a position of said carriage in the sub scanning direction.

[Claim 5] A carriage supporting structure as claimed in Claim 4, characterized in that said carriage has second guide members, said second guide members slidably contacting with said second position defining face and reciprocating in said main scanning direction with said second position defining face sandwiched between said second guide members.

[Claim 6] A carriage supporting structure as claimed in any one of Claims 1 through 5, characterized in that said carriage has a third guide member, said first

guide member and said third guide member slidably contacting with said first position defining face and reciprocating in said main scanning direction with said first position defining face sandwiched between said first and said third guide members.

[Claim 7] A carriage supporting structure as claimed in any one of Claims 1 through 6, characterized in that said recording apparatus comprises a second carriage guide plate bent in directions opposite to each other so as to have a Z-shaped section and having three faces parallel to said main scanning direction, said second carriage guide plate being formed integrally from a sheet discharge frame of said recording apparatus so as to dispose the middle face of the Z shape parallel to the head face of said recording head, said middle face of the Z shape being a third position defining face for defining a distance between the head face of said recording head and the recording surface of said recording paper and for supporting said carriage.

[Claim 8] A carriage supporting structure as claimed in Claim 7, characterized in that said carriage has a fourth guide member, said fourth guide member slidably contacting with said third position defining

face and reciprocating in said main scanning direction.

[Claim 9] Ink jet recording apparatus comprising a carriage supporting structure as claimed in any one of Claims 1 through 8.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to recording apparatus in which a carriage carrying a recording head is reciprocated in a main scanning direction and recording paper is transferred in a sub scanning direction for recording.

[0002]

[Description of the Related Art]

Conventional recording apparatus is equipped with a carriage guide shaft for supporting a carriage, and the carriage is supported by this carriage guide shaft. Fig. 4 is a side view showing a carriage supporting structure including the conventional carriage guide shaft.

[0003]

A carriage guide shaft 65 made of metal is cylindrical in shape. A carriage 51 is supported by the carriage guide shaft 65 which penetrates through a bearing

64 having a round hole formed in the carriage 51. Driving power from a rotational driving power source such as a motor is transmitted to a belt receiver 63 through a not-shown endless belt, thereby reciprocating the carriage 51 in a main scanning direction.

[0004]

The carriage guide shaft 65 not only supports the carriage 51 so that the carriage 51 can reciprocate in the main scanning direction, but also defines an interval (what is called a "paper gap", hereinafter abbreviated as "PG") between a recording head 62 attached to the carriage 51 and a recording surface of recording paper P transferred in sliding contact with a platen 52. The carriage 51 is supported on a frame member 8 using a guide member 66 to control the degree of parallelism of the head face of the recording head 62.

[0005]

[Problem to be Solved by the Invention]

As known in the art, the above-mentioned PG is a highly important factor which has great influence on the recording quality. When PG only slightly deviates from a specified value, the recording quality may differ considerably. Since the conventional carriage

supporting structure in which the carriage 51 is supported by the carriage guide shaft 65 attains high PG accuracy and keeps PG approximately constant, there is extremely little provability that the recording quality is deteriorated even if PG slightly deviates from specification. Accordingly, the carriage supporting structure is widely adopted in today's recording apparatus capable of offering high image quality recording.

[0006]

Recently, the price of recording apparatus has been increasingly declining. For cost reduction of recording apparatus, it is probably effective that a lower-cost carriage supporting structure than the above-described carriage supporting structure including the carriage guide shaft 65 is incorporated in recording apparatus.

[0007]

Under the present conditions, however, there is almost no carriage supporting structure which attains PG accuracy equivalent to that of the carriage supporting structure having the carriage guide shaft 65 and is still available at low cost.

[0008]

The present invention is directed to solve the above

problem. The object of the invention is to provide a carriage supporting structure which offers PG accuracy equivalent to that of a carriage supporting structure including a carriage guide shaft and which is less expensive.

[0009]

[Means for Solving the Problem]

In order to attain the above object, the invention claimed in Claim 1 relates to a carriage supporting structure included in recording apparatus comprising a carriage for carrying a recording head and for reciprocating in a main scanning direction, and a first carriage guide plate bent in directions opposite to each other so as to have a Z-shaped section and having three faces parallel to said main scanning direction, said recording paper being transferred in a sub scanning direction for recording; characterized in that said first carriage guide plate is formed integrally from a main frame of said recording apparatus so as to dispose a middle face of the Z shape parallel to a head face of said recording head, said middle face of the Z shape being a first position defining face for defining a distance between the head face of said recording head and the recording surface of said

recording paper and for supporting said carriage.

[0010]

When a sheet of flat metal plate is bent in one direction, the sheet of the metal plate having two faces each of which has a different angle thus formed warps in a direction opposite to the initial bending direction. Next, one of the two faces is bent in a direction opposite to the initial direction to form a Z-shaped section. The middle face of the three faces formed through bending in two directions as above is highly flat since the above-mentioned warp due to bending is cancelled by bending in two directions opposite to each other.

[0011]

The bending in Z shape mentioned herein refers to the bending in which warp due to bending is cancelled by bending in directions opposite to each other. Thus, even if the bending angle is, for example, approximately 90 degrees for bending in opposite directions so as to form a crank-like shape or a larger or smaller angle than 90 degrees, a highly flat face can be obtained with warp due to bending cancelled. Bending at these angles is all included in bending in Z shape claimed in Claim 1 of the present invention.

[0012]

The first position defining face which supports the carriage as a member of what is called a PG defining face for defining the interval between the head face of the recording head and the recoding surface of the recording paper is a highly flat face where warp due to bending is cancelled by bending in two directions opposite to each other. As a result, PG can be controlled with high accuracy. Also, since the first carriage guide plate including the first position defining face is integrally formed from the main frame without the necessity of additional components of a carriage guide shaft and a carriage guide shaft attachment such as a bushing, cost reduction of recording apparatus can be realized.

[0013]

Consequently, according to the carriage supporting structure of the invention as claimed in Claim 1, a low-cost carriage supporting structure having PG accuracy equivalent to that of a carriage supporting structure including a carriage guide shaft can be provided.

[0014]

The invention as claimed in Claim 2 relates to a carriage supporting structure characterized in that, in

Claim 1, said carriage has a first guide member, said first guide member slidably contacting with said first position defining face and reciprocating in said main scanning direction.

[0015]

As mentioned, since the first guide member equipped in the carriage slidably contacts with the first position defining face and reciprocates in the main scanning direction, the PG between the head face of the recording head attached to the carriage and the recording surface of the recording paper is controlled with high accuracy by means of the first guide member.

[0016]

Therefore, in accordance with the carriage supporting structure of the invention as claimed in Claim 2, the operational effect of the invention as claimed in Claim 1 can be obtained by employing the first guide member which is attached to the carriage and which slidably contacts with the first position defining face and reciprocates in the main scanning direction.

[0017]

The invention as claimed in Claim 3 relates to a carriage supporting structure characterized in that, in

Claim 2, said first guide member slidably contacts with said first position defining face adjacent to a center line in the sub scanning direction.

[0018]

The region adjacent to the center line in the sub scanning direction on the first position defining face is especially flat compared with other portions of the first position defining face. Since the first guide member slidably contacts with this region, the PG can be more precisely controlled.

[0019]

Consequently, according to the carriage supporting structure of the invention as claimed in Claim 3, since the first guide member slidably contacts with the first position defining face adjacent to the center line in the sub scanning direction, the operational effect of the invention as claimed in Claim 2 can be more enhanced.

[0020]

The invention as claimed in Claim 4 relates to a carriage supporting structure characterized in that, in any one of Claims 1 through 3, one of the outside faces of said Z shape of said first carriage guide plate is a second position defining face for defining the position

of said carriage in the sub scanning direction.

[0021]

As described above, the first position defining face is a highly flat face where the above-mentioned warp due to bending is cancelled by bending in two directions opposite to each other. As a result, the two outside faces are also highly flat.

[0022]

Therefore, according to the carriage supporting structure of the invention as claimed in Claim 4, in addition to the operational effect obtained from the invention as claimed in any one of Claims 1 through 3, another operational effect of controlling the position of the carriage in the sub scanning direction with high accuracy can be attained since the face outside of the first position defining face is employed as the second position defining face for defining the position of the carriage in the sub scanning direction.

[0023]

The invention as claimed in Claim 5 relates to a carriage supporting structure characterized in that, in Claim 4, said carriage has second guide members, said second guide members slidably contacting with said second

position defining face and reciprocating in said main scanning direction with said second position defining face sandwiched between said second guide members.

[0024]

As described, the second guide members equipped in the carriage slidingly contact with the second position defining face with the second position defining face sandwiched between the second guide members. The position of the carriage in the sub scanning direction can thus be controlled with high accuracy by means of the second guide members.

[0025]

Consequently, according to the carriage supporting structure of the invention as claimed in Claim 5, the second guide members provided in the carriage slidingly contact with the second position defining face with the second position defining face sandwiched between the second guide members during reciprocating movement of the carriage in the main scanning direction. The operational effect of the invention as claimed in Claim 4 can thus be obtained.

[0026]

The invention as claimed in Claim 6 relates to a

carriage supporting structure characterized in that, in any one of Claims 1 through 5, said carriage has a third guide member, said first guide member and said third guide member slidably contacting with said first position defining face and reciprocating in said main scanning direction with said first position defining face sandwiched between said first and said third guide members.

[0027]

As mentioned, since the first position defining face is sandwiched between the third guide member additionally provided in the carriage and the first guide member, the carriage position in the vertical direction can be defined.

[0028]

Accordingly, in the carriage supporting structure of the invention as claimed in Claim 6, in addition to the operational effect of the invention claimed in any one of Claims 1 through 5, another effect of preventing deviation of PG due to vibration or other cause acting on the carriage and the resultant deterioration of recording quality can be realized since the carriage position in the vertical direction is controlled.

[0029]

The invention as claimed in Claim 7 relates to a carriage supporting structure characterized in that, in any one of Claims 1 through 6, said recording apparatus comprises a second carriage guide plate bent in directions opposite to each other so as to have a Z-shaped section and having three faces parallel to said main scanning direction, said second carriage guide plate being formed integrally from a sheet discharge frame of said recording apparatus so as to dispose the middle face of the Z shape parallel to the head face of said recording head, said middle face of the Z shape being a third position defining face for defining a distance between the head face of said recording head and the recording surface of said recording paper and for supporting said carriage.

[0030]

As described, since the second carriage guide plate having the third position defining face which is highly flat as the first position defining face is formed integrally from the sheet discharge frame in addition to the first position defining face and the PG is defined by the two faces of the first and the third position defining faces, not only the PG but also the parallelism between

the head face of the recording head and the recording surface of the recording paper can be controlled with high accuracy.

[0031]

Therefore, according to the carriage supporting structure of the invention as claimed in Claim 7, an operational effect of controlling the PG with increased stability and accuracy can be attained as well as the operational effect of the invention as claimed in any one of Claims 1 through 6.

[0032]

The invention as claimed in Claim 8 relates to a carriage supporting structure characterized in that, in Claim 7, said carriage has a fourth guide member, said fourth guide member slidably contacting with said third position defining face and reciprocating in said main scanning direction.

[0033]

As mentioned, since the fourth guide member slidably contacts with the third position defining face, both of the PG and the parallelism between the head face of the recording head and the recording surface of the recording paper can be controlled with high accuracy by

means of the two guide members of the first and the fourth guide members.

[0034]

Consequently, according to the carriage supporting structure of the invention as claimed in Claim 8, the operational effect of the invention as claimed in Claim 7 can be obtained as the fourth guide member provided in the carriage slidably contacts with the third position defining face during reciprocating movement of the carriage in the main scanning direction.

[0035]

The invention as claimed in Claim 9 relates to ink jet recording apparatus comprising a carriage supporting structure as claimed in any one of Claims 1 through 8.

According to the ink jet recording apparatus of the invention as claimed in Claim 9, the operational effect of the invention as claimed in any one of Claims 1 through 8 described as above can be obtained by means of the ink jet recording apparatus.

[0036]

[Description of the Preferred Embodiment]

The preferred embodiment of the present invention is described below in conjunction with the drawings.

Fig. 1 is a schematic plan view illustrating an example of ink jet recording apparatus embodying the present invention. Fig. 2 is a side view of Fig. 1.

[0037]

Recording apparatus 50 contains a carriage 51 movable in a main scanning direction X as a means for recording on recording paper P. A recording head 62 for applying ink onto the recording paper P in recording is attached to the carriage 51. A platen 52 for defining a gap between the head face of the recording head 62 and the recording paper P is provided facing the recording head 62. With the carriage 51 transferred in the main scanning direction X and the recording paper P intermittently fed between the carriage 51 and the platen 52 in a sub scanning direction Y, the recording head 62 applies ink onto the recording paper P for recording on the recording paper P.

[0038]

A sheet feed tray 58 is configured to supply the recording paper P such as ordinary paper and photograph paper, and is provided with an ASF (automatic sheet feeder) for automatically feeding the recording paper P. The ASF is an automatic sheet feeding mechanism having two sheet feed rollers 57 attached to the sheet feed tray and a

not-shown separation pad. The rotation of the sheet feed rollers 57 is controlled by rotational driving force of a stepping motor or other driving source, and are D-shaped in appearance viewed from the side.

[0039]

One of the two sheet feed rollers 57 is positioned at one side of the sheet feed tray 58, and the other sheet feed roller 57 is attached to a recording paper guide member 59. The recording paper guide member 59 attached to the sheet feed tray 58 can slide in a direction of an arrow A in accordance with the width of the recording paper P. In feeding a plurality of sheets of recording paper P from the sheet feed tray 58, the plurality of sheets are automatically fed not at a time, but exactly one after another due to the rotational driving force of the sheet feed rollers 57 and the friction resistance of the separation pad.

[0040]

Next, the recording paper P fed automatically by the ASF is intermittently transferred downstream in the sub scanning direction Y to a recording area at a predetermined feed rate by a recording paper transfer means positioned downstream from the sheet feed rollers 57 in the sub

scanning direction Y.

[0041]

A transfer drive roller 53 and subordinate transfer drive rollers 54 are provided as the recording paper transfer means for conveying the recording paper P intermittently in the sub scanning direction Y. The rotation of the transfer drive roller 53 is controlled by rotational driving force of a stepping motor or other drive source and conveys the recording paper P in the sub scanning direction Y. A plurality of rollers are equipped as the subordinate transfer drive rollers 54, each of which is activated by the transfer drive roller 53. When the recording paper P is transferred with the rotation of the transfer drive roller 53, the subordinate transfer drive rollers 54 in contact with the recording paper P are rotated in accordance with the movement of the recording paper P.

[0042]

A sheet detector 61, which is constructed according to a technique known in the art, is disposed between the sheet feed rollers 57 and the transfer drive roller 53. The sheet detector 61 is provided with self-reset function to standing posture, and has an axis-supported lever which

protrudes into the transfer passage of the recording paper P so that the lever rotates only in the transfer direction of the recording paper. The lever revolves as the tip of the lever is pushed by the recording paper P, thereby detecting the presence of the recording paper P. The sheet detector 61 detects the initial end position and the final end position of the recording paper P fed through the sheet feed rollers 57. The recording area is determined according to the detection position and recording is thus carried out.

[0043]

Additionally, a discharge drive roller 55 and subordinate discharge drive rollers 56 are equipped as means for discharging recording paper P thus recorded. The rotation of the discharge drive roller 55 is controlled by rotational driving force of a stepping motor or other driving force. The recording paper P is discharged in the sub scanning direction Y with the rotation of the discharge drive roller 55. The subordinate discharge drive roller 56 is a teeth-provided roller having a plurality of teeth on its circumference. Each of the teeth is sharpened at an acute angle so that each tip of the teeth point-contacts with the recording surface of the recording paper P. A

plurality of the subordinate discharge drive rollers 56 are individually actuated by the discharge drive roller 55. When the recording paper P is discharged with the rotation of the discharge drive roller 55, the subordinate discharge drive rollers 56 in contact with the recording paper P are rotated in accordance with the discharge of the recording paper P.

[0044]

In the ink jet recording apparatus constructed as above, the carriage 51 carrying the recording head 62 is supported by the carriage supporting structure according to the present invention so that the carriage 51 can reciprocate in the main scanning direction. The PG (paper gap), which is an interval between the head face of the recording head 62 and the recording surface of the recording paper P to be transferred in the sub scanning walking Y in sliding contact with the platen 52, is controlled by the carriage supporting structure so as to be kept as a fixed value all the time even while the carriage 51 is reciprocating in the main scanning direction.

[0045]

Fig. 3 is a side view illustrating the carriage supporting structure according to the present invention.

The carriage 51 consists of a carriage main body 6 and a cover 7. The recording head 62 is attached to the bottom of the carriage main body 6. Not- shown various ink cartridges are contained in the carriage main body 6 to apply ink onto the recording paper P through the recording head 62. The driving power from the rotational drive source such as a motor is transmitted to a belt receiver 63 through a not-shown endless belt, and the carriage 51 thereby reciprocates in the main scanning direction X.

[0046]

A first carriage guide plate 2 is formed integrally from a main frame 5 of the ink jet recording apparatus 50. The first carriage guide plate 2 is bent in directions opposite to each other at an angle of approximately 90 degrees so as to have a Z-shaped section, thereby forming three faces parallel to the main scanning direction X. The middle face of the three faces parallel to the main scanning direction X is a first position defining face 21 for determining the PG while supporting the carriage 51.

[0047]

As described above, the first position defining face 21 is a highly flat face where warp due to bending is

cancelled by bending in two directions opposite to each other. A first guide member 11 attached to the carriage 51 slidably contacts with the first position defining face to define the PG, and the PG can thus be controlled with high accuracy.

[0048]

The two faces, which are formed from the first carriage guide plate 2 and positioned adjacent to the first position defining face 21, are highly flat similarly to the first position defining face. One of the two faces is a second position defining face 22 for defining the position of the carriage 51 in the sub scanning direction Y. Since the position of the carriage 51 in the sub scanning direction Y is determined with the second position defining face 22 sandwiched between second guide members 12 attached to the carriage 51, tilting of the recording head 62 toward the sub scanning direction Y, which results in the deterioration of the recording quality, can be prevented. Of course, the other face 23 may be the second position defining face, in which condition similar effects can be attained.

[0049]

Furthermore, the carriage 51 is provided with a third

guide member 13. As illustrated in the figure, the third guide member 13 is positioned facing the first guide member 11 with the first position defining face 21 interposed therebetween. The carriage 51 is supported on the first position defining face 21 with the first position defining face 21 sandwiched between the first guide member 11 and the third guide member 13. Consequently, not only the PG of the carriage 51 is controlled by the position defining face 21 having high flatness but also the position of the carriage 51 in a vertical direction Z is similarly determined, thereby allowing more accurate control of the PG to be attained.

[0050]

A second carriage guide plate 4 is formed integrally from a sheet discharge frame 3 where the subordinate discharge drive rollers 56 are disposed. The second carriage guide plate 4 is bent in directions opposite to each other at an angle of approximately 90 degrees to so as to have a Z-shaped section, thereby forming three faces parallel to the main scanning direction X. The middle face of the three faces parallel to the main scanning direction X is a third position defining face 41 for defining the PG of the carriage 51 in cooperation with the first

position defining face while supporting the carriage 51.

[0051]

The third position defining face 41 is a highly flat face where warp due to bending is cancelled by bending in two directions opposite to each other in the same manner as the first position defining face. A fourth guide member 14 attached to the carriage 51 slidably contacts with the third position defining face 41 to control the PG.

[0052]

Consequently, since the PG of the carriage 51 is controlled by the two highly flat position defining faces of the first position defining face 21 and the third position defining face 41, the PG can be controlled with still more accuracy. As illustrated in the figure, since the first guide member and the fourth guide member are positioned at the upstream side and the downstream side, respectively, in the sub scanning direction Y with the recording head 62 interposed therebetween, the carriage 51 can be supported in more stable condition, allowing the parallelism of the head face of the recording head 62 to be controlled with high accuracy.

[0053]

Therefore, according to the carriage supporting

structure of this embodiment, the first carriage guide plate 2 and the second carriage guide plate 4 are capable of supporting the carriage 51 while controlling the PG with high accuracy.

[0054]

Additionally, another example in which the second carriage guide plate is not provided can be embodied according to the present invention; and the operational effect of the present invention can be attained.

[0055]

The present invention is not limited to the above-described embodiment, but various modifications may be carried out without departing from the scope of the claims of the invention. Of course, these modifications are also included within the scope of the present invention.

[0056]

[Effect of the Invention]

According to the present invention, a low-cost carriage supporting structure which attains PG accuracy equivalent to that of a carriage supporting structure including a carriage guide shaft can be provided in recording apparatus.

[Brief Description of the Drawing]

[Fig. 1]

Fig. 1 is a schematic plan view showing an example of ink jet recording apparatus according to the present invention.

[Fig. 2]

Fig. 2 is a schematic side view showing an example of ink jet recording apparatus according to the present invention.

[Fig. 3]

Fig. 3 is a side view illustrating a carriage supporting structure according to the present invention.

[Fig. 4]

Fig. 4 is a side view illustrating a conventional carriage supporting structure including a carriage guide shaft.

[Description of Numeral]

- 2 First carriage guide plate
- 3 Sheet discharge frame
- 4 Second carriage guide plate
- 5 Main frame
- 6 Carriage main body
- 7 Cover

11 First guide member
12 Second guide member
13 Third guide member
14 Fourth guide member
21 First position defining face
22 Second position defining face
41 Third position defining face
51 Carriage
52 Platen
62 Recording head
P Recording paper

[Name of Document]

Abstract

[Abstract]

[Purpose]

To provide a low-cost carriage supporting structure which is included in recording apparatus and which attains PG accuracy equivalent to that of a carriage supporting structure having a carriage guide shaft.

[Means for Accomplishing the Purpose]

A first carriage guide plate 2 is bent at approximately 90 degrees in directions opposite to each other so as to have a Z-shaped section and thus forms three faces parallel to a main scanning direction X. A middle face of the three faces parallel to the main scanning direction X is a first position defining face 21 which controls PG and supports a carriage 51. The first position defining face 21 is a highly flat face where warp due to bending is cancelled by bending in two directions opposite to each other. Additionally, as a first guide member 11 attached to the carriage 51 slidably contacts with the first position defining face for PG control, PG can be controlled with high accuracy.

[Selected Figure]

Fig. 3